
**PART H
WELDING AND CUTTING**

WAC 296-155-400 Gas welding and cutting.

- (1) Transporting, moving, and storing compressed gas cylinders.
 - (a) Valve protection caps shall be in place and secured.
 - (b) When cylinders are hoisted, they shall be secured on a cradle, slingboard, or pallet. They shall not be hoisted or transported by means of magnets or choker slings.
 - (c) Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dropped, struck, or permitted to strike each other violently.
 - (d) When cylinders are transported by powered vehicles, they shall be secured in a vertical position.
 - (e) Valve protection caps shall not be used for lifting cylinders from one vertical position to another. Bars shall not be used under valves or valve protection caps to pry cylinders loose when frozen. Warm, not boiling, water shall be used to thaw cylinders loose.
 - (f) Unless cylinders are firmly secured on a special carrier intended for this purpose, regulators shall be removed and valve protection caps put in place before cylinders are moved.
 - (g) A suitable cylinder truck, chain, or other steadying device shall be used to keep cylinders from being knocked over while in use. Such cylinders are not considered to be "in storage."
 - (h) When a job is finished, when cylinders are empty or when cylinders are moved at any time, the cylinder valve shall be closed.
 - (i) Compressed gas cylinders shall be secured in an upright position at all times except, if necessary, for short periods of time while cylinders are actually being hoisted or carried.
 - (j) Oxygen. Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high having a fire-resistance rating of at least one-half hour.
- (2) Placing cylinders.
 - (a) Cylinders shall be kept far enough away from the actual welding or cutting operation so that sparks, hot slag, or flame will not reach them. When this is impractical, fire resistant shields shall be provided.
 - (b) Cylinders shall be placed where they cannot become part of an electrical circuit. Electrodes shall not be struck against a cylinder to strike an arc.
 - (c) Fuel gas cylinders shall be placed with valve end up whenever they are in use. They shall not be placed in a location where they would be subject to open flame, hot metal, or other sources of artificial heat.
 - (d) Cylinders containing oxygen or acetylene or other fuel gas shall not be taken into confined spaces.

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- (3) Treatment of cylinders.
 - (a) Cylinders, whether full or empty, shall not be used as rollers or supports.
 - (b) No person other than the gas supplier shall attempt to mix gases in a cylinder. No one except the owner of the cylinder or person authorized by the owner, shall refill a cylinder. No one shall use a cylinder's contents for purposes other than those intended by the supplier. All cylinders used shall meet the department of transportation requirements, Specification for Cylinders, (49 CFR Part 178, Subpart C).
 - (c) No damaged or defective cylinder shall be used.
- (4) Use of fuel gas. The employer shall thoroughly instruct employees in the safe use of fuel gas, as follows:
 - (a) Before a regulator to a cylinder valve is connected, the valve shall be opened slightly and closed immediately. (This action is generally termed "cracking" and is intended to clear the valve of dust or dirt that might otherwise enter the regulator.) The person cracking the valve shall stand to one side of the outlet, not in front of it. The valve of a fuel gas cylinder shall not be cracked where the gas would reach welding work, sparks, flame, or other possible sources of ignition.
 - (b) The cylinder valve shall always be opened slowly to prevent damage to the regulator. For quick closing, valves on fuel gas cylinders shall not be opened more than 1 1/2 turns. When a special wrench is required, it shall be left in position on the stem of the valve while the cylinder is in use so that the fuel gas flow can be shut off quickly in case of an emergency. In the case of manifolded or coupled cylinders, at least one such wrench shall always be available for immediate use. Nothing shall be placed on top of a fuel gas cylinder, when in use, which may damage the safety device or interfere with the quick closing of the valve.
 - (c) Fuel gas shall not be used from cylinders through torches or other devices which are equipped with shutoff valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.
 - (d) Before a regulator is removed from a cylinder valve, the cylinder valve shall always be closed and the gas released from the regulator.
 - (e) If, when the valve on a fuel gas cylinder is opened, there is found to be a leak around the valve stem, the valve shall be closed and the gland nut tightened. If this action does not stop the leak, the use of the cylinder shall be discontinued, and it shall be properly tagged and removed from the work area. In the event that fuel gas should leak from the cylinder valve, rather than from the valve stem, and the gas cannot be shut off, the cylinder shall be properly tagged and removed from the work area. If a regulator attached to a cylinder valve will effectively stop a leak through the valve seat, the cylinder need not be removed from the work area.
 - (f) If a leak should develop at a fuse plug or other safety device, the cylinder shall be removed from the work area.
 - (g) Cylinders not having fixed hand wheels shall have keys, handles, or nonadjustable wrenches on valve stems while in service. In multiple cylinder installations one and only one key or handle is required for each manifold.

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- (5) Fuel gas and oxygen manifolds.
 - (a) Fuel gas and oxygen manifolds shall bear the name of the substance they contain in letters at least 1-inch high which shall be either painted on the manifold or on a sign permanently attached to it.
 - (b) Fuel gas and oxygen manifolds shall be placed in safe, well ventilated, and accessible locations. They shall not be located within enclosed spaces.
 - (c) Manifold hose connections, including both ends of the supply hose that lead to the manifold, shall be such that the hose cannot be interchanged between fuel gas and oxygen manifolds and supply header connections. Adapters shall not be used to permit the interchange of hose. Hose connections shall be kept free of grease and oil.
 - (d) When not in use, manifold and header hose connections shall be capped.
 - (e) Nothing shall be placed on top of a manifold, when in use, which will damage the manifold or interfere with the quick closing of the valves.
- (6) Hose.
 - (a) Fuel gas hose and oxygen hose shall be easily distinguishable from each other. The contrast may be made by different colors or by surface characteristics readily distinguishable by the sense of touch. Oxygen and fuel gas hoses shall not be interchangeable. A single hose having more than one gas passage shall not be used.
 - (b) When parallel sections of oxygen and fuel gas hose are taped together, not more than 4 inches out of 12 inches shall be covered by tape.
 - (c) All hose in use, carrying acetylene, oxygen, natural or manufactured fuel gas, or any gas or substance which may ignite or enter into combustion, or be in any way harmful to employees, shall be inspected at the beginning of each working shift. Defective hose shall be removed from service.
 - (d) Hose which has been subject to flashback, or which shows evidence of severe wear or damage, shall be tested to twice the normal pressure to which it is subject, but in no case less than 300 p.s.i. Defective hose, or hose in doubtful condition, shall not be used.
 - (e) Hose couplings shall be of the type that cannot be unlocked or disconnected by means of a straight pull without rotary motion.
 - (f) Boxes used for the storage of gas hose shall be ventilated.
 - (g) Hoses, cables, and other equipment shall be kept clear of passageways, ladders and stairs.
- (7) Torches.
 - (a) Clogged torch tip openings shall be cleaned with suitable cleaning wires, drills, or other devices designed for such purpose.
 - (b) Torches in use shall be inspected at the beginning of each working shift for leaking shutoff valves, hose couplings, and tip connections. Defective torches shall not be used.

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- (c) Torches shall be lighted by friction lighters or other approved devices, and not by matches or from hot work.
- (8) Regulators and gauges. Oxygen and fuel gas pressure regulators, including their related gauges, shall be in proper working order while in use.
- (9) Oil and grease hazards. Oxygen cylinders and fittings shall be kept away from oil or grease. Cylinders, cylinder caps and valves, couplings, regulators, hose, and apparatus shall be kept free from oil or greasy substances and shall not be handled with oily hands or gloves. Oxygen shall not be directed at oily surfaces, greasy clothes, or within a fuel oil or other storage tank or vessel.
- (10) Additional rules. For additional details not covered in this Part, applicable portions of American National Standards Institute, Z49.1-1973, Safety in Welding and Cutting, shall apply.

You are also required to protect employees from exposure to hexavalent chromium during the stainless steel welding process. See WAC 296-62-08003, Hexavalent chromium for specific criteria.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-16-106 (Order 06-13), § 296-155-400, filed 08/12/06, effective 09/01/06. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-155-400, filed 7/20/94, effective 9/20/94. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-03-074 (Order 86-14), § 296-155-400, filed 1/21/86; Order 74-26, § 296-155-400, filed 5/7/74, effective 6/6/74.]

WAC 296-155-405 Arc welding and cutting.

- (1) Manual electrode holders.
 - (a) Only manual electrode holders which are specifically designed for arc welding and cutting, and are of a capacity capable of safely handling the maximum rated current required by the electrodes, shall be used.
 - (b) Any current-carrying parts passing through the portion of the holder which the arc welder or cutter grips in the hand, and the outer surfaces of the jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.
- (2) Welding cables and connectors.
 - (a) All arc welding and cutting cables shall be of the completely insulated, flexible type, capable of handling the maximum current requirements of the work in progress, taking into account the duty cycle under which the arc welder or cutter is working.
 - (b) Only cable free from repair or splices for a minimum distance of 10 feet from the cable end to which the electrode holder is connected shall be used, except that cables with standard insulated connectors or with splices whose insulating quality is equal to that of the cable are permitted.
 - (c) When it becomes necessary to connect or splice lengths of cable one to another, substantial insulated connectors of a capacity at least equivalent to that of the cable shall be used. If connections are effected by means of cable lugs, they shall be securely fastened together to give good electrical contact, and the exposed metal parts of the lugs shall be completely insulated.
 - (d) Cables in need of repair shall not be used. When a cable, other than the cable lead referred to in subdivision (b) of this subsection, becomes worn to the extent of exposing bare conductors, the portion thus exposed shall be protected by means of rubber and friction tape or other equivalent insulation.

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- (3) Ground returns and machine grounding.
 - (a) A ground return cable shall have a safe current carrying capacity equal to or exceeding the specified maximum output capacity of the arc welding or cutting unit which it services. When a single ground return cable services more than one unit, its safe current-carrying capacity shall equal or exceed the total specified maximum output capacities of all the units which it services.
 - (b) Pipelines containing gases or flammable liquids, or conduits containing electrical circuits, shall not be used as a ground return. For welding on natural gas pipelines, the technical portions of regulations issued by the Department of Transportation, Office of Pipeline Safety, Minimum Federal Safety Standards for Gas Pipelines shall apply.(49 CFR Part 192, Subpart C.)
 - (c) When a structure or pipeline is employed as a ground return circuit, it shall be determined that the required electrical contact exist at all joints. The generation of an arc, sparks, or heat at any point shall cause rejection of the structures as a ground circuit.
 - (d) When a structure or pipeline is continuously employed as a ground return circuit, all joints shall be bonded, and periodic inspections shall be conducted to ensure that no condition of electrolysis or fire hazard exists by virtue of such use.
 - (e) The frames of all arc welding and cutting machines shall be grounded either through a third wire in the cable containing the circuit conductor or through a separate wire which is grounded at the source of the current. Grounding circuits, other than by means of the structure, shall be checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current to flow to cause the fuse or circuit breaker to interrupt the current.
 - (f) All ground connections shall be inspected to ensure that they are mechanically strong and electrically adequate for the required current.
- (4) Operating instructions. Employers shall instruct employees in the safe means of arc welding and cutting as follows:
 - (a) When electrode holders are to be left unattended, the electrodes shall be removed and the holders shall be so placed or protected that they cannot make electrical contact with employees or conducting objects.
 - (b) Hot electrode holders shall not be dipped in water; to do so may expose the arc welder or cutter to electric shock.
 - (c) When the arc welder or cutter has occasion to leave work or to stop work for any appreciable length of time, or when the arc welding or cutting machine is to be moved, the power supply switch to the equipment shall be opened.
 - (d) Any faulty or defective equipment shall be reported to the supervisor.
 - (e) See WAC 296-155-452 for additional requirements.
- (5) Shielding. Whenever practical, all arc welding and cutting operations shall be shielded by noncombustible or flameproof screens which will protect employees and other persons working in the vicinity from the direct rays of the arc.

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- (6) Employee protection. Where welding or cutting operations are being performed in areas where it is possible for molten slag to contact other employees, those employees shall be protected from being burned by providing overhead protection, barricading the impact area, or other effective means.

[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-155-405, filed 7/20/94, effective 9/20/94; 88-23-054 (Order 88-25), § 296-155-405, filed 11/14/88. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-03-074 (Order 86-14), § 296-155-405, filed 1/21/86; Order 74-26, § 296-155-405, filed 5/7/74, effective 6/6/74.]

WAC 296-155-407 Protective clothing.

- (1) General requirements. Employees exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment in accordance with the requirements of chapter 296-800 WAC, and chapter 296-24 WAC, Part I. Appropriate protective clothing required for any welding operation will vary with the size, nature and location of the work to be performed.
- (2) Specified protective clothing. Protective means which may be employed are as follows:
- (a) Except when engaged in light work, all welders should wear flameproof gauntlet gloves.
 - (b) Flameproof aprons made of leather, or other suitable material may also be desirable as protection against radiated heat and sparks.
 - (c) Woolen clothing preferable to cotton because it is not so readily ignited and helps protect the welder from changes in temperature. Cotton clothing, if used, should be chemically treated to reduce its combustibility. All outer clothing such as jumpers or overalls should be reasonably free from oil or grease.
 - (d) Sparks may lodge in rolled-up sleeves or pockets of clothing, or cuffs of overalls or trousers. It is therefore recommended that sleeves and collars be kept buttoned and pockets be eliminated from the front of overalls and aprons. Trousers or overalls should not be turned up on the outside.

Note: For heavy work, fire-resistant leggings, high boots, or other equivalent means should be used.

- (e) In production work a sheet metal screen in front of the worker's legs can provide further protection against sparks and molten metal in cutting operations.
- (f) Capes or shoulder covers made of leather or other suitable materials should be worn during overhead welding or cutting operations. Leather skull caps may be worn under helmets to prevent head burns.
- (g) Where there is exposure to sharp or heavy falling objects, or a hazard of bumping in confined spaces, hard hats or head protectors shall be used.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-155-407, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 95-04-007, § 296-155-407, filed 1/18/95, effective 3/1/95. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-03-074 (Order 86-14), § 296-155-407, filed 1/21/86.]

WAC 296-155-410 Fire prevention.

- (1) When practical, objects to be welded, cut, or heated shall be moved to a designated safe location or, if the objects to be welded, cut, or heated cannot be readily moved, all movable fire hazards in the vicinity shall be taken to a safe place, or otherwise protected.

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- (2) If the object to be welded, cut, or heated cannot be moved and if all the fire hazards cannot be removed, positive means shall be taken to confine the heat, sparks, and slag, and to protect the immovable fire hazards from them.
- (3) No welding, cutting, or heating shall be done where the application of flammable paints, or the presence of other flammable compounds, or heavy dust concentrations creates a hazard.
- (4) Suitable fire extinguishing equipment shall be immediately available in the work area and shall be maintained in a state of readiness for instant use.
- (5) When the welding, cutting, or heating operation is such that normal fire prevention precautions are not sufficient, additional personnel shall be assigned to guard against fire while the actual welding, cutting, or heating operation is being performed, and for a sufficient period of time after completion of the work to ensure that no possibility of fire exists. Such personnel shall be instructed as to the specific anticipated fire hazards and how the firefighting equipment provided is to be used.
- (6) When welding, cutting, or heating is performed on walls, floors, and ceilings, since direct penetration of sparks or heat transfer may introduce a fire hazard to an adjacent area, the same precautions shall be taken on the opposite side as are taken on the side on which the welding is being performed.
- (7) For the elimination of possible fire in enclosed spaces as a result of gas escaping through leaking or improperly closed torch valves, the gas supply to the torch shall be positively shut off at some point outside the enclosed space whenever the torch is not to be used or whenever the torch is left unattended for a substantial period of time, such as during the lunch period. Overnight and at the change of shifts, the torch and hose shall be removed from the confined space. Open end fuel gas and oxygen hoses shall be immediately removed from enclosed spaces when they are disconnected from the torch or other gas-consuming device.
- (8) Except when the contents are being removed or transferred, drums, pails, and other containers, which contain or have contained flammable liquids, shall be kept closed. Empty containers shall be removed to a safe area apart from hot work operations or open flames.
- (9) Drums, containers, or hollow structures which have contained toxic or flammable substances shall, before welding, cutting, or heating is undertaken on them, either be filled with water or thoroughly cleaned of such substances and ventilated and tested. For welding, cutting and heating on steel pipelines containing natural gas, the pertinent portions of regulations issued by the Department of Transportation, Office of Pipeline Safety, Minimum Federal Safety Standards for Gas Pipelines, shall apply. (49 CFR Part 192, Subpart C.)
- (10) Before heat is applied to a drum, container, or hollow structure, a vent or opening shall be provided for the release of any built-up pressure during the application of heat.

[Order 74-26, § 296-155-410, filed 5/7/74, effective 6/6/74.]

WAC 296-155-415 Ventilation and protection in welding, cutting, and heating.

- (1) Mechanical ventilation. For purposes of this section, mechanical ventilation shall meet the following requirements:
 - (a) Mechanical ventilation shall consist of either general mechanical ventilation systems or local exhaust systems.

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- (b) General mechanical ventilation shall be of sufficient capacity and so arranged as to produce the number of air changes necessary to maintain welding fumes and smoke within safe limits, as defined in Part B of this chapter.
 - (c) Local exhaust ventilation shall consist of freely movable hoods intended to be placed by the welder or burner as close as practicable to the work. This system shall be of sufficient capacity and so arranged as to remove fumes and smoke at the source and keep the concentration of them in the breathing zone within safe limits as defined in Part B of this chapter.
 - (d) Contaminated air exhausted from a working space shall be discharged into the open air or otherwise clear of the source of intake air.
 - (e) All air replacing that withdrawn shall be clean and respirable.
 - (f) Oxygen shall not be used for ventilation purposes, comfort cooling, blowing dust from clothing, or for cleaning the work area.
- (2) Welding, cutting, and heating in confined spaces.
- (a) Except as provided in subdivision (b) of this subsection and subdivision (b) of subsection (3) of this section, either general mechanical or local exhaust ventilation meeting the requirements of subsection (1) of this section shall be provided whenever welding, cutting, or heating is performed in a confined space.
 - (b) When sufficient ventilation cannot be obtained without blocking the means of access, employees in the confined space shall be protected by air line respirators in accordance with the requirements of Part C of this chapter, and an employee on the outside of such a confined space shall be assigned to maintain communication with those working within it and to aid them in an emergency.
- (3) Welding, cutting, or heating of metals of toxic significance.
- (a) Welding, cutting, or heating in any enclosed spaces involving the metals specified in this subsection shall be performed with either general mechanical or local exhaust ventilation meeting the requirements of subsection (1) of this section:
 - (i) Zinc-bearing base or filler metals or metals coated with zinc-bearing materials.
 - (ii) Lead base metals;
 - (iii) Cadmium-bearing filler materials;
 - (iv) Chromium-bearing metals or metals coated with chromium-bearing materials.
 - (b) Welding, cutting, or heating in any enclosed spaces involving the metals specified in this subdivision shall be performed with local exhaust ventilation in accordance with the requirements of subsection (1) of this section, or employees shall be protected by air line respirators in accordance with the requirements of Part C of this chapter.
 - (i) Metals containing lead, other than as an impurity, or metals coated with lead-bearing materials;

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- (ii) Cadmium-bearing or cadmium-coated base metals;
 - (iii) Metals coated with mercury-bearing metals;
 - (iv) Beryllium-containing base or filler metals. Because of its high toxicity, work involving beryllium shall be done with both local exhaust ventilation and air line respirators.
 - (c) Employees performing such operations in the open air shall be protected by filter-type respirators in accordance with the requirements of Part C of this chapter, except that employees performing such operations on beryllium-containing base or filler metals shall be protected by air line respirators in accordance with the requirements of Part C of this chapter.
 - (d) Other employees exposed to the same atmosphere as the welders or burners shall be protected in the same manner as the welder or burner.
- (4) Inert-gas metal-arc welding.
- (a) Since the inert-gas metal-arc welding process involves the production of ultra-violet radiation of intensities of 5 to 30 times that produced during shielded metal-arc welding, the decomposition of chlorinated solvents by ultraviolet rays, and the liberation of toxic fumes and gases, employees shall not be permitted to engage in, or be exposed to the process until the following special precautions have been taken:
 - (i) The use of chlorinated solvents shall be kept at least 200 feet, unless shielded, from the exposed arc, and surfaces prepared with chlorinated solvents shall be thoroughly dry before welding is permitted on such surfaces.
 - (ii) Employees in the area not protected from the arc by screening shall be protected by filter lenses meeting the requirements of Part C of this chapter. When two or more welders are exposed to each other's arc, filter lens goggles of a suitable type, meeting the requirements of Part C of this chapter shall be worn under welding helmets. Hand shields to protect the welder against flashes and radiant energy shall be used when either the helmet is lifted or the shield is removed.
 - (iii) Welders and other employees who are exposed to radiation shall be suitably protected so that the skin is covered completely to prevent burns and other damage by ultraviolet rays. Welding helmets and hand shields shall be free of leaks and openings, and free of highly reflective surfaces.
 - (iv) When inert-gas metal-arc welding is being performed on stainless steel, the requirements of subdivision (b) of subsection (3) of this section shall be met to protect against dangerous concentrations of nitrogen dioxide.
- (5) General welding, cutting, and heating.
- (a) Welding, cutting, and heating, not involving conditions or materials described in subsections (2), (3), or (4) of this section, may normally be done without mechanical ventilation or respiratory protective equipment, but where, because of unusual physical or atmospheric conditions, an unsafe accumulation of contaminants exists, suitable mechanical ventilation or respiratory protective equipment shall be provided.

WAC 296-155-415 (Cont.)

- (b) Employees performing any type of welding, cutting, or heating shall be protected by suitable eye protective equipment in accordance with the requirements of Part C of this chapter.

[Order 74-26, § 296-155-415, filed 5/7/74, effective 6/6/74.]

WAC 296-155-420 Welding, cutting, and heating in way of preservative coatings.

- (1) Before welding, cutting, or heating is commenced on any surface covered by a preservative coating whose flammability is not known, a test shall be made by a competent person to determine its flammability. Preservative coatings shall be considered to be highly flammable when scrapings burn with extreme rapidity.
- (2) Precautions shall be taken to prevent ignition of highly flammable hardened preservative coatings. When coatings are determined to be highly flammable, they shall be stripped from the area to be heated to prevent ignition.
- (3) Protection against toxic preservative coatings:
- (a) In enclosed spaces, all surfaces covered with toxic preservatives shall be stripped of all toxic coatings for a distance of at least 4 inches from the area of heat application, or the employees shall be protected by air line respirators, meeting the requirements of Part C of this chapter.
- (b) In the open air, employees shall be protected by a respirator, in accordance with requirements of Part C of this chapter.
- (4) The preservative coatings shall be removed a sufficient distance from the area to be heated to ensure that the temperature of the unstripped metal will not be appreciably raised. Artificial cooling of the metal surrounding the heating area may be used to limit the size of the area required to be cleaned.

[Order 74-26, § 296-155-420, filed 5/7/74, effective 6/6/74.]